



DISK FILE

**SUBSYSTEMS
FOR**

Burroughs

**ELECTRONIC
DATA
PROCESSING
SYSTEMS**



DISK FILE SUBSYSTEMS FOR Burroughs

☐ **Greatest Choice of Models to Fit Your Needs**

☐ **Greatest Range of Capacities**

☐ **Highest Speeds of Operation**

☐ **Most Reliable Design**

☐ **Lowest Cost per Useable Character of Storage**

With all these clear advantages, it's hardly surprising that many businesses requiring fast computer access to large amounts of data, records and programs find the advanced line of Burroughs disk files a key reason for selecting Burroughs computers.



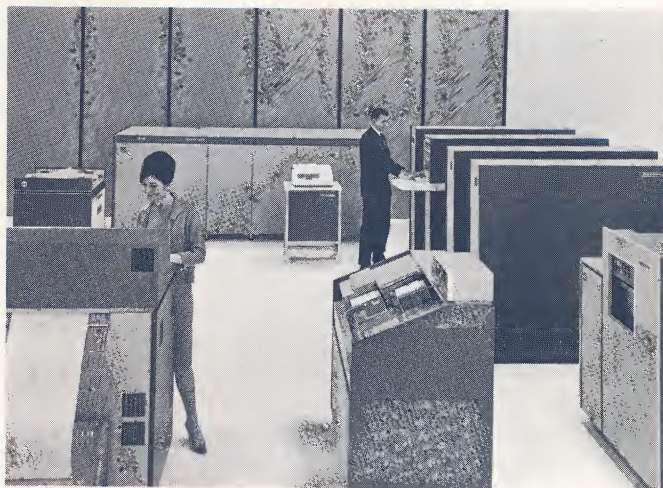
A portion of the head-per-track array of read/write heads poised over the surface of one disk in a Burroughs disk file. Heads are air-flown to within a few millionths of an inch of the vertical disk surface, and store or extract information at rates ranging from 100,000 to over 500,000 characters per second. Double exposure photo makes the metal disk appear transparent.

☐ **15 MODELS**

In 1963, Burroughs Corporation announced a random access disk file with a new, radically different design. Now, after almost three years of successful experience with installed disk file subsystems, the Burroughs line of high performance disk files has been expanded to 15 models, each subsystem available in economical increments.

They range from Systems Memory files with average access times of 17 milliseconds and capacities of one to four million bytes — offered with the new Burroughs B 2500 and B 3500 EDP Systems — to massive bulk storage devices with capacities ranging in billions of characters offered with the very large Burroughs B 8500. Combinations of two or more different disk file subsystems are available with almost all Burroughs computers. The *slowest* average access time of any of these 15 disk file models is 60 milliseconds — significantly faster than the fastest moving arm files.

ELECTRONIC DATA PROCESSING SYSTEMS



Burroughs B 3500 computer system, with 50 million bytes of Modular Random Storage disks (average access time, 20 milliseconds) in background. Combinations of at least two kinds of Burroughs disk file subsystems are available throughout every Burroughs computer series, except the small B 100.

□ HEAD-PER-TRACK DESIGN

The common denominator of all of these superior disk files is their "head-per-track" design. This design couples the recording economies of magnetic disks with the programing simplicity of magnetic core storage.

While information is recorded on rotating disks, as in all disk file devices, there are no moving read/write heads or access arms. Thus, there is no time requirement for mechanical positioning over desired information tracks on the disk surfaces. Instead, individual read/write heads are permanently positioned over each information track on each surface of each disk. Only the disks move, spinning at a constant speed under the read/write heads.

□ ALL-ELECTRONIC ACCESS

Thus, access to any part of the file is through electronic switching. Since information can be stored or retrieved in a uniform length of time—regardless of where it is placed in the file—no complicated timing considerations are involved in using the files. Similarly, the user need not spend valuable time of his systems people solving file organization problems, caused by the inherent timing complexities of a moving-arm disk file. And because access to information in the file is through electronic switching, rather than mechanical positioning, the head-per-track design results in extremely high reliability.

Burroughs users find that the total advertised capacities of Burroughs disk files are fully usable capacities. Inter-record gaps are built in as part of the file, over and beyond published capacities. It is important to examine and price out random access disk files on the basis of cost per character of usable storage in the planned applications, rather than accept theoretical capacities and costs. Burroughs disk files are significantly faster and provide extremely high performance and ease of programing and use. Yet, more often than not, total expenditures for random access storage are lower than moving-arm or other mechanical-access files.

TYPICAL USES:

TRANSITIONAL APPLICATIONS

□ SORTING

Problem: Sorting data and files typically requires 30 to 60 per cent of the operating time of a magnetic tape computer system used in a batch processing mode. Any improvement in sorting speeds usually has a measurable effect on the productivity of the installation.

The tape sorting speed of any given computer is the result of many factors. From the hardware standpoint, the chief determinates are (1) the length of the records to be sorted in relation to the amount of main memory available to the sort, and (2) the number and speed of tape units that may be used. Sorting speeds may be improved by shortening the size of the record, increasing the amount of available main memory, or increasing the number or speed of tape units. In a magnetic tape system, it is seldom practical to shorten the record. Increasing memory size or adding to magnetic tape capabilities improves the sorting operation; but there are economic limits to the extent to which this may be justified.

Solution: Many exhaustive tests have proved that a Burroughs disk file subsystem, used as a high speed sorting device, will outperform significantly more expensive magnetic tape systems. It does so by simulating large numbers of tape units. Thirty-two and sixty-four way merges are common; 128 way merges, and higher, are feasible. The simulation of this many magnetic tape units vastly improves sorting speeds.

The effect of a large increase in main memory size, at no added memory cost, is achieved by a "tag" sort method. The sort key that controls the sequencing operation is extracted from the record as it is being read into the disk file. To the sort key is added the seven-digit address of the full record on the disks. This miniature record, or "tag", is then sorted in place of the full record, providing more effective use of main memory. For example, if a file of 340-character records were to be sorted on a 10-character part number key, the tag sorting method would increase the record handling capability of main memory by 20 times. Instead of sorting strings of full 340-character records, the computer would sort strings of 17-character tags (10-character sort key plus 7-character disk file address). A significant savings in sorting time is achieved.

□ TRANSITION TO RANDOM ACCESS METHODS

Problem: Many knowledgeable computer users and manufacturers alike believe the transition to random access processing methods is inevitable for the majority of computer users. Most of the advanced business systems in use today, and planned for the future, require some random access capabilities. On-line systems, real time response systems, central file systems, integrated management information systems, and many more prosaic applications rely heavily on random access for their effectiveness. So, too, do time sharing networks and computer systems built for effective multiprocessing.

How does the typical computer user make the transition from batch to random processing methods? Must he either convert all his applications or pay for both batch processing and random access processing peripherals? How can he gain *practical* experience with a random access device *before* committing his installation, his programming staff, and his company to a new way of processing data?

Solution: With a Burroughs disk file system, with its powerful sorting capabilities, installed for efficient batch processing, the user is in the position to acquire experience and confidence in disk file programming and operation. He continues with "business as usual," maintaining his batch processing procedures, but with a gain in his installation's productivity. He and his staff acquire competence in the use of the file.

The transition from batch to random processing methods may then proceed in an orderly, controlled manner. Key related applications may be combined, reducing the number of computer runs. The user may alter processing method on a few jobs at a time without an equipment change. He can achieve whatever balance proves best between random and batch processing applications.

TYPICAL USES:

COMMON APPLICATIONS

□ REAL TIME RESPONSE

Problem: One situation often requiring random access processing is an application in which response time is critical. Airline reservation and on-line banking systems are examples. In those cases, an important objective is prompt customer service within a few seconds, while the customer waits—no matter how complex the transaction may be.

Whether the reason for requiring prompt response is tied to customer service, assembly line operation, inventory management, credit control, or other functions, the governing criterion is this question: Can the transaction or inquiry wait for batching and a scheduled updating run, or must it be handled virtually immediately?

Solution: Where files are examined or updated and fast response times are critical, the files must be (1) on-line and (2) rapidly accessed. Here, the great speed of Burroughs disk files, all of which are designed for on-line storage, may be the key to success for the application.

In the past, the limiting factor in over-all computer system response time has been the relatively slow speed of the random access device. Burroughs disk files, with average access times as low as 17 milliseconds, offer clear superiority over files with access times in the typical 75 to 250 millisecond range.

□ MULTIPLE FILE UPDATING:

Problem: A more widespread incentive for random access processing is the case of a single transaction updating many different files. Consider a product sale transaction in which the computer:

- Updates an inventory file, reducing quantity on hand and quantity reserved.
- Applies standard cost to issue quantity to give extended value at cost.
- Posts cost value of the inventory withdrawal to the accounting files.
- Applies sales price to issue quantity to give extended value of the sale.
- Posts the sale transaction to the accounting files.
- Updates the management reporting files, reducing total inventory value on hand and reserved.
- Posts the sale to the customer's record in the accounts receivable file.

This simplified order processing procedure shows a single transaction affecting five or more files. In a batch processing system, the transaction would first wait for a sufficient length of time to allow similar transactions to accumulate to make up a worthwhile batch. Five or more computer runs would then be required, with sorting and setup between runs.

While this example is typical of the kind of multiple-file updating job that often is reorganized for random access processing, it is also typical because of a "hidden" problem it contains. To handle a single transaction, the example above may require as many as 20 accesses into

the random access file to acquire the necessary program segments and records. That would consume four seconds of access time on a typical moving-arm disk file with average access times of 200 ms; on a fast model, in the 100 ms range, two full seconds. On such files, arm movement is by far the largest factor in total access time. If arm movement can be held to a minimum, these times can be improved. This consideration leads to more difficult and complex programming in an attempt to optimize record layout and file organization, and to uncertainty about what the running times will actually be. File maintenance may become highly complicated.

Solution: By contrast, a 20 ms model of the Burroughs disk file (none of which require any arm movement) would accomplish all 20 accesses in an average of only 400 ms, or four-tenths of a second. Application planning and timing estimates are simple and straightforward, since all disk file locations are accessed at a constant speed. No optimizing effort is required; there are no sophisticated record layout or programming problems.

Transactions may be entered into the Burroughs computer system at any time and without regard to sequence. The delays for batching, input sorting, and run-to-run re-sorts and setup time are all eliminated. Each transaction is processed fully in a single pass, updating all appropriate files. Because of its speed and simplicity, a Burroughs disk file makes multiple-file updating a practical, highly efficient, profitable random access application.

TYPICAL USES:

ADVANCED APPLICATIONS

□ TIME SHARING, MULTIPROCESSING, AND EXTENSION OF MEMORY

Problem: Time sharing, allowing many persons direct, concurrent access to the computer, is a relatively new application requiring random access storage to be effective. It is similar in its demands on both hardware and software to multiprocessing, in which many programs and their data share the computer system concurrently. In both cases, a major cost barrier is the requirement for extensive amounts of expensive computer memory.

For example, at a given moment you may want your computer system simultaneously to handle combinations of COBOL compilations, Fortran compilations, remote inquiries or transactions, engineering problems through a time sharing network, and regular on-site business and scientific programs. Since any of this work may "arrive" at any time, the computer system's compilers and program libraries must be available at all times. Other systems software must also be constantly present, including a powerful and comprehensive operating system. Yet a computer's main memory is very expensive; to maintain all systems and user software in main memory would be prohibitive in cost. To maintain it elsewhere, however, may be prohibitive in time.

Solution: With an array of fast head-per-track disk files available for use as an extension of the computer's main memory, Burroughs Corpora-

tion has developed compilers, operating systems, and other software items that are extremely powerful, yet highly economical to the user in terms of demands on main memory. The Burroughs disk file is also a major key to the proven implementation of multiprocessing with Burroughs computers. Except for a small portion of the operating system, all software resides on disks, together with the user's complete program library. This includes program libraries for time sharing users; working data, arrays, and constants; queued data for programs waiting to be multiprocessed; and all necessary on-line files.

Because of the speed and versatility of the disk files, only those portions of user programs, compilers, data, files, and operating system and time sharing software required at a given moment will be located in main memory. The rest are quickly available in segments that may be brought into main memory and overlaid when required. The technique of segmentation and overlay as a means of conserving main memory has in the past proved impractical because of excessive waiting time while a needed program segment is fetched into memory. Thus, many users have had to abandon this promising concept because of equipment performance limitations. Now, high speed Burroughs disk files make this "extension of memory" concept practical and economical.

□ LARGE ON-LINE INFORMATION SYSTEMS

Problem: Many firms are reaching toward a high degree of systems integration, applying the concepts of multi-file random access processing and data communications across broad areas of company operations. Such company-wide "total" information processing systems are highly complex. Among other things, they rely heavily on random access storage for their implementation. In assessing random access device capabilities for such systems, three major factors should be noted. First, most if not all of the data and files to be handled by the system should be on-line, so as to be constantly available — in fractions of a second — for computer inquiry, updating, and reporting. Second, since the activity levels of various kinds of files are different, there often is a requirement for more than one hardware level of random access storage. Highly active files are maintained in a fast device; less active files, in less expensive but slower random access storage device.

Third, and of critical importance in projects of such major scope, is the factor of change. At the very time the company's planners are attempting to integrate the firm's information system, its products, markets, facilities, key personnel, competitive position, policies, and structure all may be undergoing significant and continuing change. The information system must be viable; capable of shifting and adapting to a changing environment. To the extent that it is bound to the specific limitations and programming requirements of a machine or device, it will retard — rather than enhance — the company's responsiveness to changing business conditions.

Solution: All 15 models of the Burroughs disk file are designed for continuous on-line information storage. Further, three general levels of hardware are available. Systems Memory disks, with average access times of 17 milliseconds, are available as extensions of the computer's main

memory. Burroughs Master Control Programs, compilers, and other systems software, plus the full library of user programs, are stored in these very fast disk files. Millions of characters or bytes are available to the computer virtually instantly.

In most cases, there will be a body of information files, measured in tens of millions of characters, with high processing activity. For these high-activity files, Burroughs Corporation provides Modular Random Storage disk files with average access times of 20 and 23 milliseconds. To handle the mass of lower-activity files, often measured in hundreds of millions of characters, Data Memory Bank disk files are available. Average access times range from 20 to 60 milliseconds. They provide low storage costs for vast amounts of on-line information.

From the standpoint of dynamic adaptability to change, the optimum random storage device

would be an infinite main memory. The programming and timing simplicity of such a memory would be highly desirable because change would be facilitated. The cost, however, would exceed any reasonable criteria. Because Burroughs head-per-track disk files have the same programming characteristics and timing uniformity as main memory, they share in the important ability to facilitate change; yet they are far more economical.

Program changes are simple. Systems changes are simple. The intricate timing and programming characteristics of other random access devices, which tend to "freeze" a system because of the time, cost, and complexity of changing it, do not exist. Burroughs disk files provide an inherent flexibility that allows for record layout, program, and systems changes in a simplified, straightforward manner.

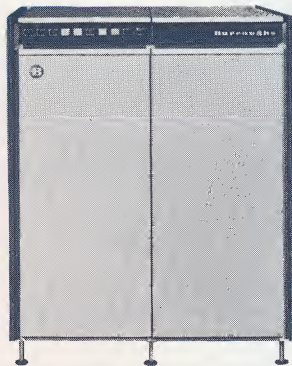
MAJOR CLASSIFICATIONS OF BURROUGHS DISK FILE SUBSYSTEMS

□ SYSTEMS MEMORY



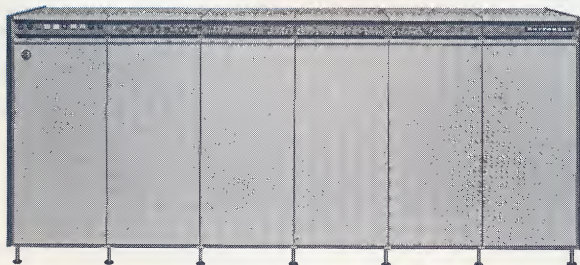
These small, fast storage units are designed as an extension of main memory. Control programs, operating software and program libraries are stored in Systems Memory and accessed when needed. Additional Systems Memory capacity may be used for records and data. Average access time is 17 milliseconds.

□ MODULAR RANDOM STORAGE



These are high speed subsystems designed to handle medium size, high activity files. In addition, a Modular Random Storage subsystem may perform all of the functions of the Systems Memory disks. Average access times are 20 and 23 milliseconds.

□ DATA MEMORY BANKS



These subsystems are characterized by low cost, high performance, and large capacity, and are designed to handle high volumes of information storage. Data Memory Banks, which feature large initial increments, may be expanded in smaller increments at a continued low cost. Average access times are 20, 23, 40, and 60 milliseconds.

Other Applications of **Burroughs** *Disk File Subsystems*

- ☐ INFORMATION RETRIEVAL
- ☐ TRANSIT AND ITEM PROCESSING
- ☐ SIMULATION
- ☐ ORDER ENTRY
- ☐ ON-LINE BANKING
- ☐ FINANCIAL CENTRAL INFORMATION FILE
- ☐ PERSONNEL ACCOUNTING
- ☐ CUSTOMER ACCOUNTING
- ☐ INVENTORY MANAGEMENT
- ☐ PATIENT ACCOUNTING
- ☐ DATA REDUCTION
- ☐ PRODUCTION SCHEDULING
- ☐ UTILITY BILLING
- ☐ PERT/CPM SCHEDULING
- ☐ ADVERTISING MEDIA ANALYSIS
- ☐ GENERAL ACCOUNTING
- ☐ ENGINEERING DESIGN
- ☐ FORECASTING



*Wherever There's
Business There's*



Burroughs